

REMARKS

Applicant respectfully requests reconsideration of this application, as amended, and consideration of the following remarks. Claims 17-22 have been previously canceled as being drawn to a non-elected invention. Claim 10 has been canceled. Claims 23 and 24 have been added. Claim 1 has been amended. Claims 1-9, 11-16, 23 and 24 remain pending. Claims 1-16 stand rejected under 35 U.S.C. 112, second paragraph. Claims 1-4, 6, 11 and 16 stand rejected under 35 USC 102(a).

Amendments

Amendments to the Claims

Applicant has amended the claims to more particularly point out what Applicant regards as the invention. No new matter has been added as a result of these amendments.

Rejections

Rejections under 35 U.S.C. §112 second paragraph

Claims 1-16 stand rejected under 35 U.S.C. 112, second paragraph as being indefinite for failing to particularly point out and distinctly claim the subject matter which Applicant regards as the invention. Applicant respectfully traverses this rejection.

Applicant draws the examiners attention to the paragraphs 36-40 of the specification which provide as follows:

“[36] In an operation 110, a first portion of the etch byproducts (e.g., as CuCl₂, CuCl, or elemental copper) can be deposited on the inner surfaces of the process chamber. In an operation 115, a remainder of the volatile etch byproducts can be output from the process chamber such as by a purge or a vacuum.

“[37] By way of example, a chlorine containing etch chemistry can etch a copper layer on the substrate, forming etch byproducts including Cu₃Cl₃, CuCl₂, CuCl and elemental copper. At the process temperature of about 200 degrees C or greater, Cu₃Cl₃ is volatile while CuCl₂, CuCl and elemental copper may not be volatile. A non-volatile first portion of the etch byproducts (e.g., CuCl₂, CuCl and elemental copper) can deposit on the inner surfaces of the process chamber even at temperatures well above 200 degrees C (e.g., greater than about 400 degrees C). A second, volatile portion of the etch byproducts (e.g., the Cu₃Cl₃) is output from the process chamber.

“[38] However, as a second portion of the Cu_3Cl_3 cools (e.g., as the Cu_3Cl_3 contacts a cooler surface such as the inner surface of the process chamber), the second portion is converted to CuCl_2 , which is not volatile at the process temperature. Therefore, while Cu_3Cl_3 is formed during the etch process, a layer of CuCl_2 can be formed on the inner surfaces of the process chamber.

“[39] In an operation 120, the inner surfaces of the process chamber are heated to the process temperature. In an operation 125, the hydrogen input with the halogen based etch chemistry can react with the layer of etch byproducts (e.g., CuCl_2) that is formed on the inner surfaces of the process chamber. The non-volatile copper chloride is reduced to elemental copper and the chlorine combines with the hydrogen to form HCl that is volatile at the process temperature.

“[40] In an operation 130, the elemental copper can react with the halogen based plasma to become one or more volatile species that can be removed from the process chamber through the outlet in an operation 135. The method operations can then end. It should be understood that the operations 105-135 are not required to be performed in the order illustrated. Some of the operations may occur substantially simultaneously or in an order other than as described.”

Referring now to claim 1, as amended, which provides:

“A method for cleaning a processing chamber comprising:

heating an inner surface of the processing chamber to a first temperature, the first temperature being sufficient to cause a first species to become volatile, the first species being one of a plurality of byproducts of a first process, the plurality of byproducts also including ~~one of~~ a plurality of species deposited on the inner surface;

injecting a cleaning chemistry into the processing chamber, the cleaning chemistry being reactive with a second one of the plurality of species to convert the second species to the first species; and

outputting the volatilized first species from the processing chamber including condensing at least a portion of the volatilized first species on a second surface that has a temperature less than the first temperature”

Claim 1, as amended more clearly claims Applicant's invention. The claimed method is a method for cleaning a process chamber. The process chamber needs to be cleaned because it has been used in a previous or even an ongoing process resulting in undesirable residues of etch byproducts (e.g., CuCl_2 , CuCl and elemental copper) remaining as deposits and other forms (i.e., vapor) in the process chamber.

Depending on the process being performed in the process chamber, the process chamber can have a temperature of less than about 200 degrees C such that even Cu_3Cl_3 can remain within and even as deposits on the surfaces of the process chamber. Therefore, before the cleaning process is initiated, the process chamber may or may not have a temperature of sufficient to cause a first species to become volatile (e.g., greater than about 200 degrees C).

Cleaning the process chamber includes heating an inner surface of the processing chamber to a first temperature, the first temperature being sufficient to cause a first species (e.g., Cu_3Cl_3) to become volatile (e.g., greater than about 200 degrees C), the first species (e.g., Cu_3Cl_3) being one of a plurality of species deposited on the inner surface.

As stated in paragraph 37 “temperature of about 200 degrees C or greater, Cu_3Cl_3 is volatile”, therefore if the first species is Cu_3Cl_3 then the first temperature can be equal to or greater than about 200 degrees C. If the process chamber already had a temperature sufficient to cause the first species to become volatile, then it may not be necessary to heat the process chamber, however, the cleaning process requires that the process chamber is at least maintained at if not heated to the temperature sufficient to cause the first species to become volatile.

The cleaning process can also include injecting a cleaning chemistry into the processing chamber, the cleaning chemistry being reactive with a second one (e.g., elemental copper) of the plurality of species to convert the second species (e.g., elemental copper) to the first species (e.g., Cu_3Cl_3).

As stated in paragraph 40: “the elemental copper can react with the halogen based plasma to become one or more volatile species”. More specifically, paragraph 37 states a halogen containing etch chemistry such as a “chlorine containing etch chemistry can etch a copper layer ... forming etch byproducts including Cu_3Cl_3 ...”

The cleaning process can also include outputting the volatilized first species (e.g., Cu_3Cl_3 including the converted second species (e.g., elemental copper)) from the processing chamber.

In an alternative scenario, the first species could be Cu_3Cl_3 , as the steps in the claims are NOT required to be performed in the order stated then, if the temperature in the chamber and the surfaces of the chamber are sufficient (e.g., greater than about 200 degrees C) for the Cu_3Cl_3 , to be volatile, then the Cu_3Cl_3 , can be output from the chamber.

However, if the surfaces of the chamber are not 200 degrees C or more then the surfaces of chamber are heated to 200 degrees C or more, at which time some of the Cu_3Cl_3 that may still reside in the chamber, will become volatilized and can then be output from the chamber.

If the surfaces of the chamber are heated to 200 degrees C or more then a cleaning chemistry can be injected into the chamber. The cleaning chemistry will react with one or more of the species deposited on the surfaces of chamber (e.g., elemental copper) to form additional quantities of the first species (e.g., Cu_3Cl_3), which will be formed in a volatile state, and can be output from the chamber.

Accordingly, Applicant respectfully submits that Applicant's invention as claimed in claims 1-16 are not indefinite, and respectfully request the withdrawal of the rejection under 35 U.S.C. §112, second paragraph.

Rejections under 35 U.S.C. §102(a)

Claims 1-4, 6, 11 and 16 stand rejected under 35 USC 102(a) as being anticipated in view of Qian (US Pat 6,699,399). Applicant respectfully traverses these rejections, as the Examiner so forthrightly pointed out that Qian does not teach each and every limitation as claimed in claims 5, 7-10 and 12-15.

Claim 1, as amended, includes the limitations of claim 10 specifically:

A method for cleaning a processing chamber comprising:

heating an inner surface of the processing chamber to a first temperature, the first temperature being sufficient to cause a first species to become volatile, the first

species being one of a plurality of byproducts of a first process, the plurality of byproducts also including a plurality of species deposited on the inner surface;

injecting a cleaning chemistry into the processing chamber, the cleaning chemistry being reactive with a second one of the plurality of species to convert the second species to the first species; and

outputting the volatilized first species from the processing chamber *including condensing at least a portion of the volatilized first species on a second surface that has a temperature less than the first temperature.* (emphasis added)

New claim 23, includes the limitations of claims 1 and 12 specifically:

A method for cleaning a processing chamber comprising:

heating an inner surface of the processing chamber to a first temperature, the first temperature being sufficient to cause a first species to become volatile, the first species being one of a plurality of byproducts of a first process, the plurality of byproducts also including a plurality of species deposited on the inner surface;

injecting a cleaning chemistry into the processing chamber, the cleaning chemistry being reactive with a second one of the plurality of species to convert the second species to the first species, *wherein the first species is at least one of a metal and halogen compound and a metal and oxygen compound, and wherein the second species is at least one of a non-volatile metal and a metal containing compound;* and

outputting the volatilized first species from the processing chamber. (emphasis added)

New claim 24, includes the limitations of claims 1, 2 and 5 specifically:

A method for cleaning a processing chamber comprising:

heating an inner surface of the processing chamber to a first temperature, the first temperature being sufficient to cause a first species to become volatile, the first species being one of a plurality of byproducts of a first process, the plurality of byproducts also including a plurality of species deposited on the inner surface, *wherein the processing chamber includes a substrate to be processed;*

injecting a cleaning chemistry into the processing chamber, the cleaning chemistry being reactive with a second one of the plurality of species to convert the second species to the first species;

outputting the volatilized first species from the processing chamber; and

heating the substrate. (emphasis added)

Accordingly, Applicant contends that claims 1, 23 and 14 are patentable over the cited prior art references. Claims 2-9 and 11-16 depend from claim 1 and are patentable of the cited prior art references for at least the same reasons as claim 1. Applicant therefore requests the rejections to claims 1-16 under 35 USC 102(a) be withdrawn and claims 1-9, 11-16, 23 and 24 be found allowable.

SUMMARY

In view of the foregoing amendments and remarks, Applicant respectfully submits that the pending claims are in condition for allowance. Applicant respectfully requests reconsideration of the application and allowance of the pending claims.

If the Examiner determines the prompt allowance of these claims could be facilitated by a telephone conference, the Examiner is invited to contact George B. Leavell at (408) 749-6900, ext 6923.

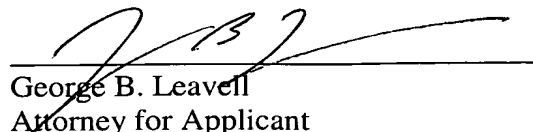
Deposit Account Authorization

Authorization is hereby given to charge our Deposit Account No. 50-0805 (Ref LAM2P460) for any charges that may be due or credit our account for any overpayment. Furthermore, if an extension is required, then Applicant hereby requests such extension.

Respectfully submitted,

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